

What is claimed is:

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- 5 1. A trailer based collision warning system comprising:
a sensor control unit having at least one sensor coupled thereto, the sensor control unit capable of determining an object within a predetermined field of view for each sensor coupled thereto, and within a predetermined detection range;
a driver vehicle interface coupled to the sensor control unit, the driver vehicle interface configured to receive signals from the sensor control unit representative of objects determined by the sensor control unit;
10 a display unit coupled to the driver vehicle interface capable of providing a visual representation of objects determined by the sensor control unit, wherein the trailer based collision warning system is adapted for mounting to a trailer.
- 15 2. The trailer based collision warning system of claim 1, wherein the predetermined detection range is programmable for each sensor.
- 20 3. The trailer based collision warning system of claim 1, wherein the trailer based collision warning system receives power and signals from a cable coupled to a trailer for providing power and signals when the trailer is coupled to a tractor.
- 25 4. The trailer based collision warning system of claim 1, wherein the display unit includes a set of lights capable of being mounted on a right side of a trailer, and another set of lights capable of being mounted on a left side of the trailer, both sets of lights viewable by a driver of a tractor in the tractor side view mirrors.
5. The trailer based collision warning system of claim 1, wherein the sensor control unit is capable of controlling a plurality of individual sensors including one or more types of sensors.

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6. The trailer based collision warning system of claim 5, wherein the sensor control unit is capable of controlling radar, ultrasonic, laser, ladar, video, and infrared sensors.

5 7. The trailer based collision warning system of claim 1, further including a first sensor control unit controlling a plurality of radar sensors, a second sensor control unit controlling a plurality of radar sensors, a third sensor control unit controlling two ultrasonic sensors and a radar sensor, wherein the sensors of the third sensor control unit are capable of being rear mounted to a trailer, the sensors of the first sensor control unit are adapted to mounting to a right side of the trailer, the sensors of the second sensor control unit are adapted to mounted to a left side of the trailer.

10 8. The trailer based collision warning system of claim 1, wherein the driver interface unit includes a processor and memory for directing the sensor control unit, receiving information from the sensor control units, and transferring detection information to the display unit.

15 9. The trailer based collision warning system of claim 1, wherein the driver vehicle interface and the sensor control unit perform a built-in test function each time power is applied to the trailer based collision warning system and continue to perform built-in test functions while the trailer based collision warning system is in operation, and wherein a malfunction in the trailer based collision warning system is reported by the driver vehicle interface through the display unit.

20 10. The trailer based collision warning system of claim 1, wherein the system includes multiple video cameras connected to a video switch which is controlled by the driver vehicle interface.

11. The trailer based collision warning system of claim 10, wherein the video switch includes a wireless transmitter to transmit a video image of an area in which a hazard is detected to a driver in a cab of the vehicle to which the trailer is mounted, when hazard conditions are communicated to the driver vehicle interface.

12. The trailer based collision warning system of claim 1, wherein the system includes:

a sensor to determine the speed of the trailer,
a detector to determine that the trailer is slowing down, and
a brake light interface to activate the brake lights on the trailer when the trailer is slowing down.

13. The trailer based collision warning system of claim 1, wherein the display unit includes:

a plurality of lights;
a housing containing the plurality of lights for providing weather protection and mounting to a trailer; and
a signals interface coupled to the plurality of lights for receiving signals to activate the individual lights of the plurality of lights, wherein the plurality of lights are configured to provide detection information and status information when activated.

14. The display unit of claim 13, wherein the plurality of lights comprise LEDs.

15. The display unit of claim 13, wherein the signals interface includes a data communications transceiver, storage register, and drive circuitry to activate the individual lights.

16. The display unit of claim 13, wherein the signals interface comprises individual signal conducting lines coupled to the individual lights of the plurality of lights.

5 17. The display unit of claim 13, wherein the plurality of lights are configured according to a color coding scheme.

10 18. The display unit of claim 17, wherein the color coding scheme of the plurality of lights includes a status indication, a right side indication, a left side indication, a rear indication, and ranging information.

15 19. The display unit of claim 13, wherein the plurality of lights are configured to provide ranging information, wherein an individual light indicates two ranges of distance information, one range corresponding an individual light on in a steady manner, a second range corresponding to the individual light blinking at a predetermined rate.

20 20. The display unit of claim 19, wherein the plurality of lights includes four LEDs providing seven ranges of distance information.

21. The display unit of claim 20, wherein the seven ranges of distance information cover a total range from less than 1 foot to up to 100 feet.

25 22. A trailer based collision warning system comprising:

a sensor control unit having at least one sensor coupled thereto, the sensor control unit capable of determining an object within a predetermined field of view for each sensor coupled thereto, and within a predetermined detection range;

a driver vehicle interface coupled to the sensor control unit, the driver vehicle interface configured to receive signals from the sensor control unit representative of objects determined by the sensor control unit;

an audio unit coupled to the driver vehicle interface capable of providing an audio indication representing objects determined by the sensor control unit, wherein the trailer based collision warning system is adapted for mounting to a trailer.

23. The trailer based collision warning system of claim 22, wherein the predetermined detection range is programmable for each sensor.

24. The trailer based collision warning system of claim 22, wherein the system includes:

a sensor to determine the speed of the trailer,

a detector to determine that the trailer is slowing down, and

a brake light interface to activate the brake lights on the trailer when the trailer is slowing down.

25. The trailer based collision warning system of claim 22, wherein the driver vehicle interface and the sensor control unit perform a built-in test function each time power is applied to the trailer based collision warning system and continue to perform built-in test functions while the trailer based collision warning system is in operation, wherein a malfunction in the trailer based collision warning system is reported by the driver vehicle interface through the audio unit.

26. The trailer based collision warning system of claim 22, wherein the driver interface unit includes a processor and memory for directing the sensor control unit, receiving information from the sensor control units, and transferring detection information to the audio unit.

27. The trailer based collision warning system of claim 22, wherein the audio unit includes a first power line carrier interface unit coupled to the driver vehicle interface capable of superimposing information signals onto vehicle battery power wires.

28. The trailer based collision warning system of claim 27, wherein the first power line carrier interface unit coupled to the driver vehicle interface superimposes information signals onto the vehicle battery power wires that are capable of being received by a second power line interface unit coupled to a speaker for providing audible information.

29. The trailer based collision warning system of claim 22, wherein the audio unit includes an optional port for diverting non-audio information to a visual display unit for providing visual information representing objects determined by the sensor control unit.

30. The trailer based collision warning system of claim 28, wherein the second power line interface unit is capable of being mounted on a tractor, the first and second power line interface unit adapted for interfacing with vehicle battery power wires common to the tractor and trailer on which the first and second power line interface units are mounted.

31. The trailer based collision warning system of claim 22, wherein the audio unit includes a first wireless data transceiver coupled to the driver vehicle interface for receiving information from the sensor control units, the first wireless data transceiver capable of transmitting the received information.

32. The trailer based collision warning system of claim 31, wherein the first wireless data transceiver transmits the received information to a second wireless data transceiver coupled to a speaker for audibly providing information.

5 33. The trailer based collision warning system of claim 32, wherein the first and second wireless data transceivers utilize Bluetooth™ wireless technology.

34. The trailer based collision warning system of claim 32, wherein the first and second wireless data transceivers adhere to IEEE 802.11 wireless standards.

10 35. The trailer based collision warning system of claim 32, wherein the second wireless data transceiver and the speaker are capable of being permanently mounted or temporarily connected in a tractor.

15 36. The trailer based collision warning system of claim 32, wherein the second wireless transceiver and speaker comprise an adaptor, wherein the adaptor is capable of being coupled to an auxiliary power outlet of a vehicle.

20 37. The trailer based collision warning system of claim 36, wherein the auxiliary power outlet of a vehicle is a cigarette lighter receptacle.

25 38. The trailer based collision warning system of claim 32, wherein the speaker audibly provides information indicating status conditions, right side indication, left side indication, rear indication, and ranging information.

39. A portable warning system comprising:
an information display to communicate warning information to a driver of a vehicle; and

an adaptor capable of being coupled to an auxiliary power outlet of the vehicle, wherein the adaptor includes a power line carrier interface circuit for receiving collision warning information superimposed on a vehicle battery power wiring, the collision warning information being communicated to the driver by the information display.

40. The portable audio warning system of claim 39, wherein the information display includes a speaker for providing information audibly.

41. The portable warning system of claim 40, wherein built-in test results are communicated through the speaker.

42. The portable audio warning system of claim 40, wherein the speaker audibly provides information indicating status conditions, right side indication, left side indication, rear indication, and ranging information.

43. A trailer based collision warning system comprising:

a sensor control unit having at least one sensor coupled thereto, the sensor control unit capable of determining an object within a predetermined field of view for each sensor coupled thereto, and within a predetermined detection range;

a driver vehicle interface coupled to the sensor control unit, the driver vehicle interface configured to receive signals from the sensor control unit representative of objects determined by the sensor control unit;

a alarm unit coupled to the driver vehicle interface capable of providing a representation of objects detected by the sensor control unit, wherein the trailer based collision warning system is adapted for mounting to a trailer.

44. The trailer based collision warning system of claim 43, wherein the

predetermined detection range is programmable for each sensor.

45. The trailer based collision warning system of claim 43, wherein the system includes:

- a sensor to determine the speed of the trailer,
- a detector to determine that the trailer is slowing down, and
- a brake light interface to activate the brake lights on the trailer when the trailer is slowing down.

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46. The trailer based collision warning system of claim 43, wherein the driver vehicle interface and the sensor control unit perform a built-in test function each time power is applied to the trailer based collision warning system and continue to perform built-in test functions while the trailer based collision warning system is in operation, and wherein a malfunction in the trailer based collision warning system is reported by the driver vehicle interface through the alarm unit.

47. The trailer based collision warning system of claim 43, wherein the driver interface unit includes a processor and memory for directing the sensor control unit, receiving information from the sensor control units, and controlling the alarm unit.

48. The trailer based collision warning system of claim 43, wherein the alarm unit includes units capable of providing visual and audio representations of objects determined by the sensor control unit.

49. The trailer based collision warning system of claim 43, further including a direction of motion sensor to provide direction information to the sensor control units or the driver vehicle interface.

50. The trailer based collision warning system of claim 49, wherein the direction of motion sensor is adapted for sensing the direction of rotation of a trailer axle or a trailer wheel.

5 51. The trailer based collision warning system of claim 49, wherein the direction of motion sensor is a Hall effect sensor.

10 52. The trailer based collision warning system of claim 43, further including a black box recorder coupled to the driver vehicle interface for recording information about the trailer.

15 53. The trailer based collision warning system of claim 52, further comprising a G-Force switch coupled to the black box for detecting a collision, and a rollover sensor coupled to the black box for detecting a rollover condition, wherein the recording of information is automatically terminated by a collision or by a rollover condition.

20 54. The trailer based collision warning system of claim 52, wherein the information recorded includes status of the trailer based collision warning system, status of individual components of the trailer based collision warning system, and location and rate of closure information for all objects near the trailer.

25 55. The trailer based collision warning system of claim 52, wherein the information recorded includes information recorded for a predetermined period of time before a collision.

56. The trailer based collision warning system of claim 55, wherein the predetermined period of time is programmably set in the black box recorder.

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57. The trailer based collision warning system of claim 55, wherein the predetermined period of time for which information is stored before a collision is about four minutes.

5 58. The trailer based collision warning system of claim 43, further including a wireless communication system coupled to the driver vehicle interface capable of transmitting and receiving information related to the trailer to which the trailer based collision warning system is mounted.

10 59. The trailer based collision warning system of claim 58, wherein the information transmitted by the wireless communication system includes status of the trailer based collision warning system, status of individual components of the trailer based collision warning system, driver performance information, near-accident data, or actual accident data.

15 60. The trailer based collision warning system of claim 59, wherein the wireless communication system is configurable for transmitting the information to a predetermined location on demand, at specific time intervals, or based on predetermined events.

20 61. The trailer based collision warning system of 59, wherein the information is stored in the memory of the driver vehicle interface or in a black box recorder coupled to the driver vehicle interface.

25 62. The trailer based collision warning system of 58, wherein the wireless communication system includes a processor and memory for storing information related to the trailer, driver performance, near-accident data, or actual accident data.

5 63. The trailer based collision warning system of claim 43, further including a security feature built into the driver vehicle interface that utilizes existing collision warning sensors of one or more types along with additional sensors capable of determining alarm conditions, wherein the alarm conditions include unauthorized opening of trailer doors, unauthorized opening of fluid valves, unauthorized movement of the trailer, and movement of persons in close proximity to the trailer for a preprogrammed period of time.

10 64. The trailer based collision warning system of claim 63, wherein the security alarm unit has a security mode activated with a key switch mounted on the side of the trailer.

15 65. The trailer based collision warning system of claim 64, wherein when an alarm condition is detected, a high volume audible alarm is sounded for a period of approximately 30 seconds once every five minutes until the alarm condition is eliminated or the key switch mounted on the side of the trailer is turned off, the audible alarm on/off periods of time being programmable.

20 66. The trailer collision warning system of claim 63, further including a wireless communication system coupled to the security alarm unit, wherein the security alarm unit upon determining an alarm condition automatically activates the wireless communication system to transmit a security alarm code to a land-based terminal.

25 67. A trailer based collision warning system comprising:
a first sensor control unit having at least one sensor coupled thereto, the first sensor control unit capable of determining an object within a predetermined field of view for each sensor coupled thereto, and within a predetermined detection range;

a first driver vehicle interface coupled to the first sensor control unit, the first driver vehicle interface configured to receive signals from the first sensor control unit representative of objects determined by the first sensor control unit;

5 a second sensor control unit having at least one sensor coupled thereto, the second sensor control unit capable of determining an object within a predetermined field of view for each sensor coupled thereto, and within a predetermined detection range;

10 a second driver vehicle interface coupled to the second sensor control unit, the second driver vehicle interface configured to receive signals from the second sensor control unit representative of objects determined by the second sensor control unit, the second driver vehicle interface coupled to the first driver vehicle interface;

15 a alarm unit coupled to the first driver vehicle interface capable of providing a visual representation of objects determined by the first and second sensor control units, wherein the trailer based collision warning system is adapted for mounting to a trailer.

68. The trailer based collision warning system of claim 67, wherein the predetermined detection range is programmable for each sensor.

20 69. The trailer based collision warning system of claim 67, wherein the system includes:

25 a sensor to determine the speed of the trailer,
a detector to determine that the trailer is slowing down, and
a brake light interface to activate the brake lights on the trailer when the trailer is slowing down.

70. The trailer based collision warning system of claim 67, wherein the first driver vehicle interface and the first sensor control unit perform a built-in test

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function, and the second driver vehicle interface and the second sensor control unit perform a built-in test function each time power is applied to the trailer based collision warning system and continue to perform built-in test functions while the trailer based collision warning system is in operation, and wherein a malfunction in the trailer based collision warning system is reported by the first driver vehicle interface through the alarm unit.

71. The trailer based collision warning system of claim 67, wherein the first sensor control unit, the first driver interface unit and the alarm unit are adapted for mounting to a first trailer, wherein the second sensor control unit, and the second driver interface unit are adapted for mounting to a second trailer when the first trailer and the second trailer are coupled together.

72. The trailer based collision warning system of claim 71, wherein the first driver interface unit is coupled to the second driver interface unit by a tractor trailer cable coupled between the first trailer and the second trailer used to provide power and turn indications with additional signals passed between the first and second driver interface units using power line carrier interface circuits coupled to the vehicle battery power wiring.

73. The trailer based collision warning system of claim 67, wherein the first driver vehicle interface communicates with the second driver vehicle interface using wireless data transceivers mounted in each driver vehicle interface.

74. A trailer based visual display unit comprising:
multiple indicator lights for displaying status and parametric information associated with a trailer;
a mounting to attach the trailer based visual display unit on the trailer; and

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a receiver of control information to activate the trailer based visual display unit in a manner that communicates meaningful information to a driver.

5 75. The trailer based visual display unit of claim 74, wherein the trailer based visual display unit is capable of being mounted on one or both sides of the trailer.

10 76. The trailer based visual display unit of claim 75, wherein the trailer based visual display unit is visible to a driver in side view mirrors of a tractor pulling the trailer.

15 77. The trailer based visual display unit of claim 75, wherein the trailer based visual display unit is contained in a waterproof low profile assembly that is not prone to damage from passing vehicles, tree branches, or garage door frames.

20 78. The trailer based visual display unit of claim 74, wherein the indicator lights have an intensity that is automatically adjusted to compensate for variation in lighting conditions external to the trailer.

25 79. A portable warning system comprising:
an information display to communicate warning information to a driver of a vehicle; and

an adaptor capable of being coupled to an auxiliary power outlet in the vehicle, wherein the adaptor includes a wireless receiver for receiving collision warning information and video information originating from a trailer coupled to the vehicle.

80. The portable warning system of claim 79, wherein the information display includes a speaker for providing information audibly.

81. The portable warning system of claim 80, wherein built-in test results are communicated through the speaker.

82. The portable warning system of claim 79, wherein the information display includes a visual representation of trailer-based collision warning system status, side detection, rear detection, and rear range information.

83. The portable warning system of claim 79, wherein the video information represents a video image of an area adjacent to the trailer, the area related to the collision warning information and video information.